

Magmatic–Hydrothermal Evolution and Overprinting in the Guinaoang Porphyry Cu–Au System, Mankayan District, Philippines

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The Guinaoang porphyry Cu–Au deposit is located southeast of the world-class Lepanto high-sulfidation epithermal and the Far Southeast porphyry deposits in northern Luzon. Despite its proximity to these major mineralized centers, vein paragenesis and timing of mineralization at Guinaoang remain poorly constrained. Understanding the evolution of this system is critical for evaluating its relationship to the broader magmatic–hydrothermal architecture of the Mankayan Mineral District (MMD).

Mineralization is hosted by Cretaceous Lepanto Metavolcanics and Pliocene diorite–dacite porphyry intrusive units. Three principal alteration assemblages are recognized: (1) deep magnetite–hydrothermal biotite, (2) chlorite–white mica, and (3) pervasive white mica–pyrite, overprinting earlier formed assemblages. XRD analyses of strongly argillized drill core intervals identified pyrophyllite, dickite, and possible alunite, suggesting high-sulfidation epithermal overprint of the porphyry system.

Five porphyry-related vein stages are distinguished based on cross-cutting relationships, followed by late sulfate-dominant veins. Early magnetite–quartz veins (Stage 1) and wavy quartz-rich veins (Stage 2) contain trace chalcopyrite and bornite. Quartz–sulfide veins (Stage 3) host native gold occurring as inclusions in chalcopyrite, along chalcopyrite–bornite grain boundaries, and as free gold within quartz. Chalcopyrite-rich veins (Stage 4) also contain abundant native gold, whereas late pyrite-rich veins (Stage 5) are associated with white mica–pyrite halos, disseminated bornite, and contain electrum and gold tellurides as minute inclusions. These veins are crosscut by anhydrite–pyrite–quartz veins, which are in turn cut by late anhydrite veins.

Fluid inclusion assemblages in quartz consist of coexisting vapor-rich and halite-bearing multiphase inclusions, indicating fluid immiscibility during porphyry-stage mineralization. The presence of advanced argillic alteration assemblages and telluride-bearing mineralization indicates a magmatic–hydrothermal system overprinted by later acidic fluids. These observations provide additional constraints on the magmatic–hydrothermal evolution of the Guinaoang deposit and its relationship to the metallogenic framework of MMD.